View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

"DO THE RIGHT THING": INNOVATION DIFFUSION AND RISK DIMENSIONS IN THE PASSAGE FROM CONVENTIONAL TO ORGANIC AGRICULTURE

Carmelo Cannarella, Valeria Piccioni

National Research Council of Italy (CNR), Institute of Chemical Methods (IMC)

Research Team on Development and Innovative Processes

Email : c.cannarella@imc.cnr.it, v.piccioni@imc.cnr.it

Manuscript received: March 13, 2009; Reviewed: October 19, 2009; Accepted for publication: October 26, 2009

ABSTRACT

Risk is quintessential in agricultural activities and the introduction of innovation in a farm always implies additional risks difficult to quantify and identify in advance. Surely farm's internal and external sources of risk or kind of activities determine a complex entrepreneurial scenario but also psychological attitudes, feelings and behaviours of the individuals involved, a co-shared mentality and contextual culture may play a critical role as well. The case of the passage from conventional to organic agriculture exemplifies how a better understanding of "risk" and the related facets, perspectives and questions may provide relevant contributions to overcome the commonly shared idea of innate conservatism/impulsiveness in certain firms, economic sectors or class of entrepreneurs, to explain many cases of irrational resistance to innovation and to fill that frequent gap between technologists and farmers in the evaluation of the possibilities to adopt and implement also those innovations and new technologies necessary to achieve a more sustainable agriculture.

Keywords: risk, innovation, organic agriculture, resistances, rural development

INTRODUCTION

The relations between agriculture, innovation and risk cover a wide spectrum of dimensions, implications and operative fields making the entire discussion a particularly complex and sensitive issue, not only according a sector point of view but also for public opinion as a whole, and a peculiar challenge for techno transfer and innovation diffusion agents.

As some relevant studies have evidenced [4], "risk" focuses a relevant attention in the current debate about societal dynamics with unavoidable implications for the links between agriculture, innovation and technologies. Conventional "industrial" agriculture is presently seen as a *risky activity* according to several perspectives. The implementation of industrial approaches and visions to agriculture remarkably contributed to more than triple world annual agricultural production during the past century: food security and abundance was largely made possible by the development and use of innovations and new technologies such as chemical fertilizers, pesticides and herbicides, new hybrid crop varieties, the application of irrigation in arid regions, and the introduction of powered farm machinery. The benefits achieved have however come at high costs: farmers' health is *put at risk* by the use of chemicals and, out of all human activities, this kind of agriculture is considered as the source of greatest human impact on the environment. Agriculture contributes to climate change and reversely climate change negatively impacts agriculture through extreme weather events, altered seasons and changing precipitation patterns. In addition a too much industrialized food system has lowered food quality materialized in increasing diffusion in advanced economies of chronic diseases linked to diet (obesity, heart diseases, strokes, Type 2 diabetes and cancer): in several occasions, food is thus *putting at risk* human health. In the same time the modern large scale agrobusiness, with its exasperated dynamics, *is putting at risk* the existence of many farmers and rural communities in developing countries because in several cases it has aggravated rather than solved their conditions [39].

This complex scenario is strictly linked to the role technology and innovation have played so far: paradoxically many present barriers to forms of sustainable agriculture and rural development as well as to the production of healthier food do not result from "non-adoption" problems but rather from the adoption of certain innovations and technologies promoted in the past.

This dilemma thus explains the nature of the challenge innovation diffusion and techno transfer experts have to deal with: often in their minds resistances, opposition and non adoption still remain negative responses to innovation. Is it always true? Is non adoption always negative? Are resistance to innovation caused by risk perceptions in farmers always negative signals as well? How risk perception in farmers, as component of their own knowledge, may contribute to identify new technological trajectories for example to better redirect innovation and new technologies towards sustainability in agriculture?

Consider the case of the decision about the transition from conventional to organic agriculture: this is a sort of crossroad where a farmer is called to adopt some innovations necessary to convert to organic and reject others involving conventional agriculture and vice versa if deciding to maintain conventional agriculture. This case exemplifies how the key-issue is not the simple alternative between adoption/non adoption but rather what kind of innovations and new technologies are worth adopting and reasonable for farmers.

The question is what "reasonable" really means for farmers: many farmers decide to convert to organic, not only for economic reasons, but also because they believe that organic methods involve less risks for the environment seeking at the same time a less risky food supply. Yet the transition period from conventional to organic cropping systems often may represent a barrier to adopt organic approaches because considered a risky phase. During this period towards certification, farmers cannot earn economic benefits from organic productions yet and yields may temporarily be decreased for increased weed pressures or nutrient deficiencies as new crop rotations are becoming established. Farmers may also need to acquire different machinery and undertake training and learning processes which may lead to reduced income as farmers learn new production methods. In brief, in addition to the capital resources expended, there is risk of the failure in solving environmental problems or the generation of inadequate anticipated environmental benefits and outcomes and consequently the creation of frustrations, disappointment and mistrusts.

All this is translated into a risky environment for farmers which deeply influence their motivations and their decision-making in the choice between conventional and organic agriculture [14].

A risk analysis may provide relevant contributions in the understanding economic and operational motivations and causes hampering the passage to organic production and the reason why conventional agriculture is preferred even when the related risks are well known to farmers. In addition, even if connected to many traditional practices and natural cycles, the passage to organic agriculture requires specific skills and know how must be developed: farmers must be in the adequate conditions in applying

knowledge, using new approaches, improving their understanding, practicing new methods and techniques and determining processes and factors that influence decisions. In brief, these are typical features and characteristics of the activation of an innovative process which implies support and robust links of scientific research and extension institutions capable also to positively contribute to activate development processes at local level. Nonetheless, moving from theory to practice, one can easily realize that the creation of these links is not an easy task: several reasons may cause these difficulties among which the commonly shared idea, in development agents, researchers or innovation and technology transfer experts, that farmers are structurally conservative entrepreneurs plays a not secondary role. They are in fact accused of having scarce innovative and management culture and incapability to think in terms of development, of showing high individualism and irrational worries to modify consolidated practices, over-evaluating their own experiences. These conservative behaviours may thus materialize a severe obstacle even for the introduction and diffusion of those (technological/ non technological) innovations necessary to promote a modern "less risky agriculture", to provide positive contributions in reversing territorial socio-economic decline, to foster adequate local development in terms of quality of life of rural communities, to produce better and safer food, to achieve environmental protection, to support the generation of renewable energy at farm level, to generate new and more careers and jobs in farming, to revitalize local rural cultures, etc..

These "prejudices" often result from conventional approaches to innovation diffusion essentially based on the notion that knowledge transfer is fundamentally an uni-directional process, being science the only generator of new ideas, methods and practices, directed to solve specific technical issues and to pour doses of technical facts and messages, in the worst cases, towards "ignorant, ungrateful and backward farmers". The eventual insurgence of resistances to innovation becomes an adjustment and adaptation problem mainly caused by inadequacies in information circulation, communication problems or irrational oppositions to changes. These conditions may be exacerbated by the fact that researchers and farmers often know little about each other. All this frequently generates a conflict between "adversaries" who consider many aspects of the other's world, being not immediately evident and comprehensible, low profile issues. Frequently researchers tend to be not interested in many issues considered crucial by farmers and vice versa.

The resulting gap, as some empirical observations have highlighted [9], may result by the effect of the collision of two antithetical visions: the operational point of view of an innovation rarely collimates with the pure technical and scientific one. This discrepancy is often translated into personal contrasts between technicians and farmers: often innovations and changes are suggested by one side and rejected by the other. New technologies are generally directed to improve production but in the real world their implementation is submitted for example to an economic point of view: economically viable and technically perfect combinations do not always coincide and the opposition of a farmer to innovations is not simply due to ignorance or indolence because sometimes technologically inferior methods can be better adapted to given conditions. At a superficial level the eventual rejection of a given innovation may be triggered by differences in the concept of utility but different considerations of the involved risks may generate even more profound contrasts between farmers' reactions and professionals' considerations: technologies, innovations, innovative approaches to farm management, are mainly examined from the experts' point of view while farmers consider them too risky in terms of capital exposure, time, efforts and energy. These reactions, often labelled as irrational behaviour and reactions, seem maybe less well recognised and poorly studied. Surely some aspects of the problem are well known and more easily manageable in conventional terms, such as economic or technical risk mitigation of a given innovation, while others may put the entire topic under a completely different light.

Clarifying the concept of risk and its varying nature thus become critical steps for the definition and implementation of knowledge and innovative clusters within renewed technological trajectories on the base of an integration between the technical (econometric and managerial models and approaches) and the human side of the issue (psychological and cultural topics).

This integration is an essential step also to understand why do two individuals coping with the same risky decision related to innovation make different choice, why does the same individual sometimes make choices that are apparently inconsistent or when and how is an agent a concretely more risk averse than an agent b. These questions are particularly relevant for those immediately concerned with development both at farm and territorial level: often the introduction of innovation has to cope with many operational and practical issues and questions to which many theoretical models seem unable to provide concrete answers to fit in the real world. These models often appear essential contributions for the understanding, analysis and description of certain phenomena "on paper" but face remarkable limits when

development operators try to implement concretely these models and approaches.

The present study is based on activities and observations carried out within the research activities of the project "Development Dynamics and Increases in Competitiveness of Rural Areas" (DICRA) resulting from an agreement between the Research Team on Development and Innovative Processes at the Institute of Chemical Methods (I.M.C.) of the National Research Council of Italy (C.N.R.) and the Municipality of Vitorchiano (a 4000 inhabitants village in the province of Viterbo, about 100 km north of Rome in Central Italy).

This paper results from the researches conducted about causes and sources on inertial behaviours among farmers and other local agents in the rural area interested by the project. Risk aversion actually resulted as a relevant source of inaction and no choices hampering innovation adoption as confirmed by many replies from contacted and interviewed people in the survey. The role of risk aversion in activating inertial responses has thus stimulated our questioning about the involved mechanisms with the adoption of specific further analyses and reflections on the interviews and questionnaires of 10 local farmers using the case of the transition from conventional to organic agriculture: these analyses have permitted to identify some interrelated problematic dimensions deriving from these different natures of risk where synthetically many risk variables can be grouped:

- Economic dimension;
- Sector (agricultural) dimension;
- Innovation dimension;
- Behavioural dimension.

A detailed analysis of risk in organic agriculture is not the aim of this study but rather to provide, also on the base of some empirical observations and considerations, some operative contributions in the description of the main characteristics and features of these dimensions and their interrelations capable to produce relevant influences during the decision-process in the choice between different farm management approaches with critical effects in the modalities through which innovations are adopted or rejected.

The dimension of Economic Risk

"A conversion to organic agriculture is too risky, too many extra costs", "There's little market space for organic products", "Too much uncertainty, too many norms and regulations", "Opting for organic is risky because there are too many changes in farm organization: all this is expansive", "If it doesn't work, I'll lose a lot of money",

One of the most difficult topics when talking with farmers and other rural entrepreneurs is in general how to define risk. Risk is depicted as a vague and opaque object where a sense of discomfort, losses and uncertainty live side by side with fear of changes and hazard when facing certain kind of decisions. The essential idea underlying the concept of risk is the image of an exposure to a potential loss or damage: in the attempt to achieve a favourable outcome may be hidden the possibility that some negative event will occur. It means that the decision maker may be aware of the probability of the existence of a potential loss (whose dimensions may be not fully acknowledged) deriving from some present processes or future events: risk and uncertainty are thus linked by a somewhat relation. In some studies risk and uncertainty are identified as different concepts [3] being the former connected to known probabilities (quantitative and measurable dimension) while the latter related to unknown probabilities (non-quantitative and non-measurable dimension). Uncertainty hence mostly describes the environment in which certain decisions are made while risk characterizing the relevant implications of uncertainty.

A provision of an exhaustive survey about a definition of risk is not the aim of the present paper: however it is important to highlight some relevant studies [19, 37] which have been essentially focused on the analysis of risk variability (deriving from outcome uncertainty or lack of knowledge about potential outcomes), feelings of risk (deriving from outcome expectations i.e. degree of disappointment in case of negative results or from outcome impacts and their potential to act as a threat) and in general on individual/group risk behaviour (reactions coping with risk decisions).

In the commonly shared opinion, risk is correlated only to the negative effects deriving from the action of a number of different classes of variables from different dimensions: nature (earthquakes, storms, hurricanes), technology (failures, faults, imperfections, defects, costs), human (errors, inabilities, incapability, unintentional actions), etc.. having however economic implications and consequences. As any other entrepreneur, a farmer has to cope with several kind of risks: risk to fail, risk to misjudge, risk to misunderstand, risk to lose, risk to waste money and time, etc.. When coping with unreliable and doubtful activities, risk is considered by entrepreneurs a cost to be moderated often implying psychological discomforts, changes in praxes and operative rules, time and money consuming correction activities, etc.. These conditions may be exacerbated in case of contexts characterized by high levels of uncertainty and competition, certain strategies adopted, prior experiences, historical period,

geographical location, etc..

In certain circumstances risk may be beneficial for an efficient firm because it creates stimuli for adaptation to changing conditions: on the contrary inefficient firms are likely to be particularly weak to risks which have to be absolutely avoided. Changes are thus impeded, innovation diffusion altered, new products'/services' formulation hampered, renewed organization models denied, etc..

Economic risks may be initially grouped into two main classes of risk: internal and external firm's risks. Internal risks usually derives from firm's inner structural capability/vulnerability towards changes or the introductions of innovations due to unwillingness (fear to change, consolidated and ossified interests, cultural and mental factors) and/or an inability (organizational problems, difficulties in decision making processes or incapability in perceiving opportunities and need to change) to take risk choices. Firms characterized by high risk aversion levels essentially try to avoid a violation of predictability in the (internal/external) operative context risky choices may erode mainly confiding to familiar standards, routines and patterns sometimes even when potentially better alternatives have become available [31, 41, 51]. Relying on routines and on familiar patterns may be a positive strategy for managing risk but when routines are too rigid and ossified, they may become a symptom of an excessive and pathological conservative firm behaviour. These behaviours are influenced by several factors such as:

a) the firm's cultural risk values - inner values influencing the tendency to tolerate or avoid certain levels of risk and the tendency to prefer stability/certainty instead of instability/uncertainty;

b) conformism;

c) organizational control systems - those mechanisms influencing the modalities through which outcomes of risky decisions are rewarded or punished and/or risk taking/risk avoiding is encouraged or discouraged with incentives/disincentives to undertake/refuse risky initiatives.

In addition a firm's risk behaviour may be altered and exacerbated by different forms of decisions' pathologies

Table 1 Types of operative risks

Type of Risk	*Definition*
Low risk (remote)	low probability and low damage caused by the undesired event occurring, not occurred before, easy to control, low financial impact, limited impacts on firm's strategies and operative activities, modest individual concern
Mid risk (possible)	mid probability and mid damage caused by the undesired event occurring, it could occur more than once within the time period, difficult to control, moderate financial impact, moderate impacts on firm's strategies and operative activities, moderate individual concern
High risk (probable)	potential of its occurring several times within the time period, it has occurred recently, high probability and high damage caused by the undesired event occurring (dread risk - perceived lack of control, catastrophic potential, fatal consequences, inequitable distribution of risks and benefits, etc…), high financial impacts, significant impacts on organization's strategies or operational activities, significant individual concern
Unknown risk	vague ideas and visions of unexpected effects and consequences from the undesired event occurring (unobservable, unknown, new and delayed in the manifestation of harm)
Avoidable risk	undesired event which can be prevented from occurring
Acceptable risk	tolerable level of damages caused by the undesired event occurring which can be easily predicted and managed

such as myopia (wrong opinions and visions for example on long term issues or about the effects of long term investments caused by excessive prudence/ impulsiveness), negation (denial to take into account certain information about risky events), vested values (ossified and deep rooted values) or capabilities gap (lack of specific capabilities required to cope with a choice involving risk).

Internal sources of risk may be aggravated or accompanied by external risks related to the volatility of the marketplace or the peculiarities of certain activities which may be more risky than others. The complexities of physical and economic systems they rely on and the characteristics of the operative scenario and processes (which may be characterized by factors and dynamics that cannot be forecast with absolute accuracy) may pose these activities on rather fragile bases. The immediate implication of the presence of uncertainty clouds for the economic agents concerned is that a considerable variety of possible outcomes is usually associated with each chosen action or decision related of different classes of risks (table1).

A quantification of risk has been at the core of studies in several disciplines in particular in applied economics, through the Expected Utility (EU) and Prospect theories (and the notion of "risk aversion") [2, 28, 45, 48, 54], and in management studies focused on "risk management" [20, 59] (analytical tools and strategies directed to create a systematic and gradual process focused on keeping under control different kinds of risk at strategic, economic, technical implementation and operational level).

In general terms, these studies have been biased on the modalities through which economic decisions, directed to achieve the optimal allocation of scarce resources, are made involving: a) obtaining information from the environment regarding possible actions; b) valuing those actions, and c) choosing between them. According to these theoretical models these processes are, in principle, measurable and they can be articulated mathematically describing optimization problems that generate empirically testable predictions.

The behaviour of an economic agent in risky conditions can consequently be expressed through a line encompassing: a) risk aversion – the assurance of the expected result (value) is always preferred to an uncertain higher value one; b) risk neutrality – agent's indifference between a guaranteed expected result and an uncertain one and c) risk tolerance/propensity – the agent's choice is given to an uncertain and risky higher value option rather than the assurance of the expected result (value).

Some studies have identified the "Safety First" principle to describe a decision maker's reactions when coping with risk decisions. According to this principle individuals tend to make decisions trying to reduce the possibilities of falling below some minimum which may be economically or culturally identified [58]. Coping with different risky options, individuals should tend to opt for choices showing the lowest probability of falling below some economic minimum regardless of the expected potential results in order to reduce the occurring of certain economic damages. In particular, this principle often is used to explain causes and sources of forms "rural" conservatism toward innovation and change: these forms of risk aversion, expressed by a too rigid adherence to tradition or custom are conventionally found in ignorance or lack of education which push this minimum to a very high level. High risk aversion degree in farmers thus should result from a crude and rational cost-benefit analysis about their real and perceived uncertain and precarious enterprise economic situations and/or eventual real and perceived difficult enterprise economic situations as effects of risky decisions which unavoidably translated risk aversion into innovation rejection.

On the base of these premises, the degree of risk aversion should decline with wealth because the marginal value of one euro when an individual is poor is higher than he is rich. Many mathematical models developed by economic theory have been however criticized: as many studied have evidenced [36, 17], these models seem unable to describe and explain many circumstances in which risk aversion appears characterized not only by an economic rationale but also by a substantial amount of "heterogeneity" which, for the conventional economic theory, remains unexplained. Given this heterogeneity, many aspects of economic risk aversion are likely to have a sort of unobservable nature in economic empirical analyses where the eventual insurgence of different attitudes could be simply labelled as irrational behaviours: but is it always true?

The dimension of Sector Risk: conventional and organic agriculture

"Organic agriculture is unprofitable", "Yields are lowered", "With organic methods you'll cultivate only weeds". "Before passing to organic agriculture, I thought it was not reliable", "I'm already struggling with conventional agriculture: I don't want to embrace additional risks with the organic one"

Agriculture per se is a typical example of risky activity because risk and uncertainty constitute essential features of the production environment [22, 26, 27, 40]. Typical risks may derive for example by the fact that agriculture directly depends on natural and biological cycles: thus weather, infesting and pathological agents or plant pests

Table 2: Classification of Risks in Agriculture

Source of risks	Description
Weather	Risks with predictable frequency: hail, frost, wind
	Risks with unpredictable frequency: drought, flood, storm
Production Factors	Factors' productivity: i.e. not suitable seeds
	Factors' contamination: i.e. mycotoxins
	Factors' limitation: i.e. agro-environmental restrictions
Infesting and Pathological Factors	Infesting plants
	Fungi
	Viruses
	Insects
	Combined pathological diseases
Output characteristics	Health and hygienic standards
	Production quality: contract standards, quality standards
	Service quality: i.e. agritourism
Innovation and technology	Too complex
	Hard to manage
	Not compatible with farm objectives
	Not flexible enough
	Unprofitable
	Too expansive
	Too much additional learning required
	Unclear and conflicting information
Producer's skills	Inadequate management skills
Marketplace	Price volatility
	Scarce transparency
	Contracts' terms and conditions
Finance and Credit	Access to credit
	Variable interest rates
	Variable tax rates
Institutional factors	International trade agreements
	Quotas
	Environmental constraints

and diseases may represent remarkable sources of risks. Other sources of risks are generated by the interaction of large number of variables originating from:

a) Production uncertainty: farmers cannot foresee with certainty quantity and quality of their productions on the base of a given amount of inputs for the action of some uncontrollable elements for example weather or time when long production lags are biologically necessary in crop and livestock production.

b) Price uncertainty: production lags causes that many agricultural production decisions have to be made far in advance of realizing the final product on the base of a limited knowledge about the market price for the output. This condition is aggravated by high market volatility generated by demand fluctuations, a large number of competitive producers, a relatively homogeneous output, etc. Production uncertainty and price uncertainty are strictly correlated because prices adjust according to output's quantity and quality and to market forces and viceversa.

c) Technological and innovation uncertainty: due to production uncertainty and time lags, the impacts from the adoption of certain innovations and new technologies cannot be valuated in advance. For this reason innovation success/failure deeply influences final results when correction measures have limited effects.

d) Policy uncertainty; economic policies have impacts on all sectors through for examples taxes, interest, rates, exchange rates, regulation, provision of subsidies and incentives, etc. In case of contexts characterized by an intricate system of government interventions, a confused normative framework, continuing changes in policy interventions and strategies, all this constitutes a relevant source of uncertainty and considerable risks for investments.

The combined and simultaneous actions of these different sources and forms of risk make the decision environment

for farmers and other rural entrepreneurs particularly complex and uncertain (table 2). Even if farmers, in certain circumstances, may adopt strategies and tools to reduce these risks thanks to some protection approaches (technical interventions or insurances), risks may severely affects choice process and ultimately may also alter the capability of the decision maker to correctly focus the nature itself of the problems involved in the decision process with relevant consequences for the possibility to positively manage them.

In organic agriculture (real/perceived) risks may be exacerbated for its major resilience on the natural processes of ecosystems and for the exclusion of substantial risk management tools such as synthetic chemicals and antibiotics commonly adopted in conventional agriculture [16]. In addition, to reduce economic exposure risks, the transition to organic production must be analyzed also in economic terms in order to identify future economic opportunities, evaluate those realities already operating in the territory and market dynamics.

It means that organic agriculture shares some typical risks of conventional agriculture which however have to be differently managed: organic farmers have to highly rely on their understanding and management of cultural practices (crop rotation, timing of planting and harvesting, mechanical cultivation, beneficial insects, etc..) to deal with many classes and types of risk. Other risks may be classified as temporary risks such as shortages in organic inputs or as in the case of those arising during the transition period (generally three years) from conventional to organic: yields may drop, economic return may be reduced, etc.. The risk of contamination of land or crops with prohibited chemicals or genetically-modified organisms (GMO's) is an example of persisting over time risk facing an organic farmer which may involve the loss of organic certification and loss of markets. As many surveys have confirmed, the potential pest and weed outbreaks during the so-called "ecological" transition period and GMO contaminations cause major concerns in farmers acting as main source of risk in organic agriculture [21].

The presence of several distinct sources of risks in conventional/organic agriculture thus generates a complex network of interactions among different variables, which may occur at several points in time, whose analytical description may become a very difficult task. In literature several stylized theoretical models and empirical analyses have been developed which generally describe decision making dynamics based on the rational idea of the farmer's profit maximization [40]. In the same time, being economic risk a function of individual wealth, poorer farmers are more risk vulnerable: the presence of high risk aversion among these farmers could thus be explained by their attempt to reduce their exposure to avoidable risks.

The case of the conversion to organic agriculture may however highlight that concepts such as utility maximization, income levels, differences in wealth as well as farming methods, technical aspects or farm structure are surely important variables but cannot explain per se the heterogeneity of choices in a risky environment because also personal values and visions may play a critical role in decision making and in the modalities through which innovation is adopted or rejected.

The risk to innovate

"I prefer not to risk", "Too many changes", "Before becoming an organic farmer I knew very little about it: I contacted some researchers looking for information because I didn't know what to do and what to expect from the transition to organic", "I prefer to keep on doing what I have always done"

The transition from conventional to organic agriculture provides an interesting example where technical experts and farmers often may shows forms of disagreement when evaluating a given innovation disputing whether the involved risks are more or less acceptable/tolerable or existent/inexistent. This situation may result by the fact that ecological and environmental reasons or economic incentives are not always sufficient to motivate farmers to adopt organic approaches and to bring about changes. The idea of the organic farmer as a "back-to-land" type is completely misleading because organic farming requires adequate management and marketing skills, commitment, deep understanding of ecological systems, information, access to research results and links research institutions and proper training.

Switching from usual and familiar practices and methods to an unknown system may become a difficult task for the presence of several constrains causing blocking effects deriving by uncertainty. These conditions are typical features of innovation which is by definition a risk condensed issue because knowledge about innovation features and implications is generally incomplete; it is unclear how innovation will perform, when it will be fully operative and how it will affect the relative actors' positions. Thus innovation, uncertainty and implicit/explicit risks are strictly linked.

Any innovative process may be included within a continuum between two extremes: from a) low scope, risk and profile, slow evolutionary and incremental changes which do not modify the general framework to b) high scope, risk and profile, radical, strategic and disruptive ones [15, 38]. Innovation adoption and implementation

involves a mix of these features implying a number of choices and decisions generally influenced by the decision maker's experience and familiarity with the situation/ problem as critical tools in limiting risk magnitude thanks to past ability to manage and solve similar problems. The scarce and incomplete information base, usually accompanying innovation, limits this individual ability and familiarity: for this reason problem framing, or the modalities through which a situation is presented to a decision maker in a positive or negative light, plays a critical role in representing an innovation (and the related consequences) as an opportunity or a problem in terms of gains and losses.

Problem framing processes are highly influenced by "cultural transmission", Word–of-Mouth (WOM) and imitation mechanisms at the base of innovation diffusion which in literature is described by the S-shaped cumulative curve [24, 50] (figure 1).

In this curve, which describes the normal innovation adoption or the innovation degree distributed throughout the population, adoption time and innovation are inversely correlated: it assumes that few individuals (with a high inclination to innovation) will constitute the first adopters' group, the majority will adopt innovation

Table 3: Categories of Innovation Adopters

Category	Features
innovators	rather isolated individuals showing the ability to understand and apply complex technological/non technological knowledge, to cope with high risk and uncertainty about the innovation (*very low risk aversion*) and to stimulate the flow of innovation into a firm. They are inclined to adopt innovation on the base of limited evidence
early adopters	better integrated individuals showing the ability to understand and apply technological/non technological knowledge, to cope with mid risk and uncertainty about the innovation (*low risk aversion*) and to trigger the critical mass when they adopt an innovation
first majority	they adopt innovation just before the average number of the group and interconnect the next large group to innovation. Innovation decision period for this group is relatively long but adopt innovation with deliberate willingness. *Mid risk aversion*
late majority	they adopt innovation just after the majority by economic necessity or through peer pressure. This group is sceptical and cautious and they do not adopt a new idea unless most neighbouring people have done so. This group demands that most of the uncertainty and risk of innovation is removed before they are ready to adapt (*high risk aversion*)
stragglers	they take decisions about innovation in terms of what has been done previously interacting primarily with others that have traditional values. Stragglers tend to be suspicious of innovation and change agents. Their inertia and resistance to innovation can appear somehow irrational but it may be entirely rational from their point of view, as they must be sure that a new idea will not fail before the can adopt it (*very high risk aversion*)

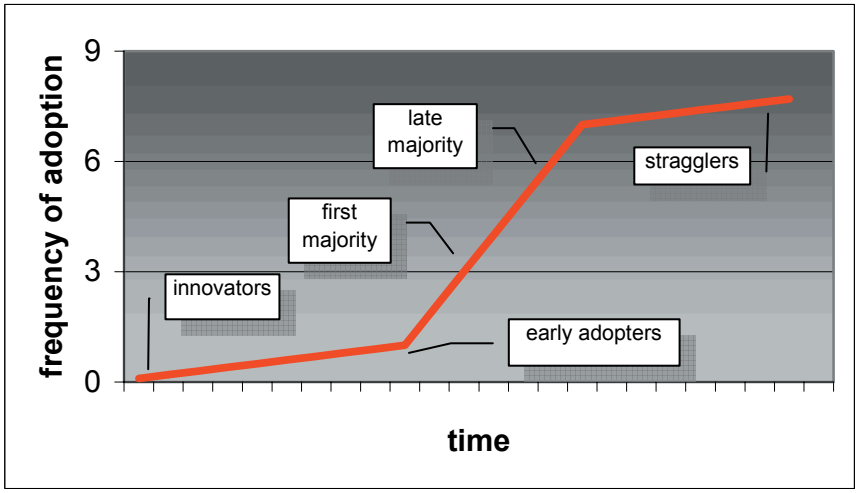

Figure 1 S-Shaped Curve of innovation's adoption

within an intermediated period and few individuals (with a limited innovativeness) will lag behind adopting innovation lately. This S-curve thus delineates different adopters' categories on the base of their behaviour (table 3).

In the configuration of these adoption categories, risk plays a critical role: many studies [24, 25] have confirmed that first adopters usually are more risk prone, with a more elevated social status and financial resources. This is to say that wider social networks or prominent social status have scarce influence on the individual possibility to innovate but they may become critical factors for innovation diffusion among the majority because, being a cultural pattern, also a risk behaviour can be transmitted in social networks through conformism (how many have adopted/rejected) or prestige (who has adopted/rejected) increasing/hampering the frequency of its adoption. This determines specific scenarios based on the characteristics of social networks operating around certain individuals and their capability to spread, also through WOM, risk feelings and behaviours. These mechanisms, together with emotional pushes and individual attitudes to risk are at the base of certain reactions towards innovation having often more impact than scientific or technical/technological evaluations of objective rational economic risk levels: often experts judge risk in a strict correlation with technical estimates of innovation failure while a farmer rejects the same innovation because he/she has been told that there is the risk of economic losses, hazards, lack of control, etc..

This gap in visions and perspectives is based on the fact that every innovation (technological/non technological) has a unique bouquet of qualities that appears to be related to its perceived risk. Many conflicts between experts and farmers regarding the adoption of certain innovations and the acceptability of the related risks, are the result of different perspectives of risk, producing different assessments of the magnitude of the risk of a given action or technology, rather than differences in the acceptability of the levels of risk.

When a farmer has to deal with the decision to invest in organic agriculture with extra costs (i.e. re-tooling, purchasing additional equipment, extra storage requirements, addition labor, etc..) and an inevitable "learning curve" (associate with managing a new system), he/she has an incomplete knowledge about the capability of the investment to be really worth adopting. He/she is facing a dilemma: he/she may decide to opt for organic hoping that this choice will become profitable, but the investment may turn out to be unprofitable. He/she may also decide to delay his/her decision, waiting for more technical information, see the others' behaviour, listen to eventual suggestions but in the meanwhile this will mean a potential loss if the innovation turns out to be profitable.

These questions accompanied any "standard" innovative cycle (**figure 2**) which can be divided into three main periods (**table 4**).

The identification of these periods and phases highlights the critical role time plays within the entire cycle: if decisions and operative choices are made in a too long time, due to high risk aversion levels in the decision maker, the innovation potentials of period B will progressively decrease. On the other hand a too short period C or too impulsive decisions might activate *adaptation* problems and the related risks. The adoption of incorrect choices thus may provoke sudden increases in risk aversion levels with consequent phenomena of inertia, fierce oppositions to innovation, sabotage and luddism. Period C is essentially related to a modification

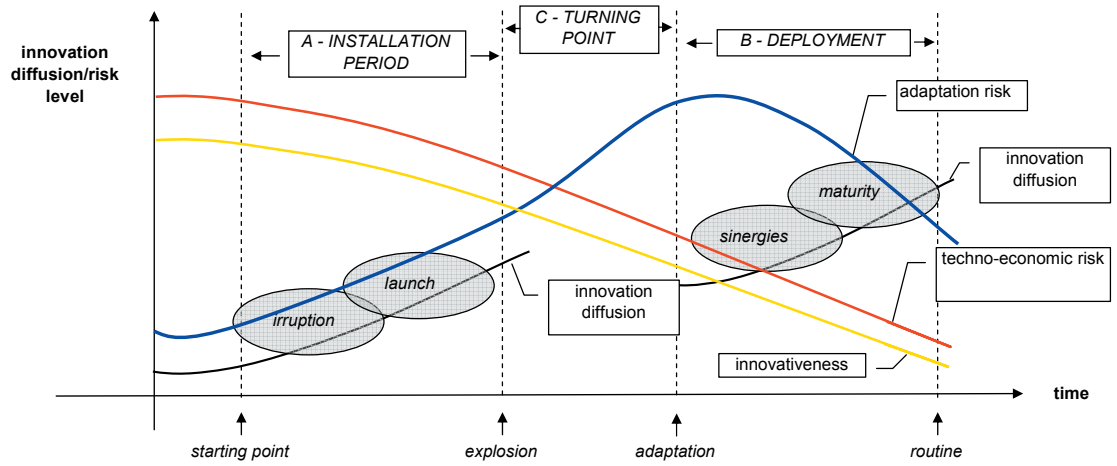

Figure 2: an innovative cycle and risks levels

Table 4: Periods and Phases of the Innovative Cycle

Type of Period	Characteristics
Period A	In this period innovation irrupts into the farm in exploration, experimentation, planning and first exploitation phases with the first eventual economic benefits of innovation. Innovation is "young": it shows high economic potential because it detains its maximum level of novelty and originality and provides high levels of competitiveness. To a high economic potential corresponds a parallel high risk potential: something "new" is always linked to uncertain factors which cannot be fully analyzed and evaluated in advance and its introduction can generate unexpected results.
Period B	This is a deployment period implying an adjustment phase which ends with a maturity phase. This period is characterized by increases in innovation maturity which progressively loses its innovative character. Activation of routines, simplified and standardized processes. Innovation shows a limited economic potential with a parallel decrease in risk and uncertainty.
Period C	Intermediate and critical phase during which operative choices and decisions are adopted to move from A to B period. During this turning point phase many evaluations about risk in economic, technical and adaptation terms are carried out producing remarkable variations in risk aversion degree within a farm.

in risk nature connected to innovation: during period A risk essentially depends on technical issues connected to innovation potential failure and costs, while during period B it depends mainly on cultural and learning issues in the human resources involved. C period, being highly characterized by decision making processes, may thus influence modes and times in which A and B periods are managed, creating extremely different results in the farming approach.

If a farmer remarks his intention to reduce economic, technical and adaptation costs related to innovation, thus confirming his/her *high risk aversion degree,* he/she is showing his/her limited unwillingness to enter period A: he/she prefers to activate mainly a period B. The approaches necessary to cope with this kind of farms are likely to be essentially biased on *imitation* and manageable predictability with higher emphasis on the possibility to copy from others' experience thus reducing the risk of innovation (technical and economic) failure. Fewer risks mean reduced unexpected and sunk costs and limited internal conflicts during the implementation phase; this kind of farm will enter the market late, through paths already explored and exploited by others (first majority/ late majority of adopters). Particularly conservative farmers (late majority of adopters and stragglers) tend even to imitate at the end of period B when innovation has entered a maturity and routine no risk phase.

On the contrary farms showing high responsiveness to innovation and a related low risk aversion degree tend to enter period A and, after an extremely short period C, quite rapidly pass towards (rather short) period B also to be ready for a subsequent innovative cycle. These farms are mainly focused on the left side of the diagram: they are highly based on innovation which can potentially generate great economic benefits, being the first to enter the market during B period, but having to deal with parallel higher risks. These farmers have to be adequately informed about higher risks linked to innovation failure and costs at experimental and implementation stage and, above all, about those levels of farm's *flexibility* necessary to cope with adjustment problems. This flexibility degree hence has to be carefully evaluated in advance to grant adequate success margins to the innovative process adopted.

The behavioural dimension: when risk emotions become operative and economic variables

The above sections have highlighted the role of some critical factors in determining risk within each dimension such as utility maximizing, time constraints, income, costs and benefits, expenditures reduction, farm flexibility, etc.. Nonetheless, many behavioural patterns always underlie the performing dynamics within the above described dimensions because finally the idea to "do the right thing" inspires individual choices and the eventual adoption or rejection of a given innovation: this notion results also by behavioural reactions to risk.

In everyday experience, we may notice that feelings of risks [30, 35] emerge when taking a decision about a choice whose expected outcomes are uncertain and the potential outcome set may include some extreme consequences. Risk derives from a chain composed of choices, decisions, uncertainty, outcomes, consequences but also expectations and prospects. The articulation of this chain highly depends on decision maker's behaviour

on the base of his:

- risk propensity - the individual's risk taking tendency [52] which expresses a general individual willingness to take risks also influencing the modalities through which risks are evaluated or considered more or less acceptable;
- risk preferences – they materialize risk propensity [12] translating also the individual attitude to avoid failure, the individual inclination to undertake specific risky decisions or not and to take or avoid specific risks;
- risk perceptions - the decision maker's assessment of the risk inherent in a situation [43], defined in terms of the decision maker's labelling of situations, probabilistic estimates of the extent and controllability of risk and the confidence in those estimates; they may have a relevant role in decision maker's behaviour because they may drive to deny uncertainty, overestimate or underestimate risks, wrong judgements and knowledge and limit the individual ability to perform under risk conditions.

In general terms, a decision maker's behaviour coping with a risky decision is the result of the contemporary and often conflicting action of emotional forces (fear, anxiety, passion reasons and motivations, etc.) and rational forces (costs and benefits, advantages and disadvantages, voluntary analyses and decisions, practical motivations and scopes, probability or desirability of associated consequences, etc.). The interplay between these two dimensions may be complicated by the choice characteristics as in the case of complexity (making a choice based on complex decisions or perceived as such) which may increase anxiety in individuals caused by the fear of making the wrong choice. In theory emotional reactions and cognitive/rational evaluations should normally work in concert to guide decision making but many studies [30, 34, 35, 55] have evidenced that when emotional reactions diverge from cognitive evaluations, emotional reactions often exert a dominating influence on behaviour. Consequently emotional reactions to risks may diverge from cognitive evaluations on the same risk with the generation of emotions in conflict with cognitive rational evaluations pushing individuals for example towards a decisions clearly diverging from rationale, inertia, impulsive decisions. Further factors may amplify or reduce this divergence [35]: immediacy of a risk, probabilities that the outcomes are different from the way they are expected, time lag between decision and the outcome of the decision, vividness or preparedness to certain emotional reactions, intuition, automatic and quick reactions, images and associations, fear, dread, anxiety, etc.. The simultaneous interplay among these factors may push individuals also to overweight/underweight rare events [46] thus influencing risk assessment.

The prevailing of emotional forces over rational ones, and their insensitiveness to variations in probability may explain why, in certain circumstances, a small percentage of the occurrence of a certain outcome may provoke great concern and concomitant effort to avert it (risk aversion) or imprudent behaviours. In addition, individual response to the consequences of rare events on the base of personal experience of adverse consequences may lead to precautionary or self protective behaviour increasing feelings of worry and decreasing personal feelings of controllability in certain situations.

Some studies [18] have highlighted that warnings on risk may be more effective when they are linked to people and anecdotes than when they are based on statistics (psychophysical numbing) evidencing that personal emotions, experiences or events interesting known people may predominate over crude statistical data or cost-benefit evaluations.

All this confirms that a decision maker under risk frequently tend to evaluate risk cognitively (costs and benefits, outcomes, probabilities, etc.) but to react to it emotionally (fear, anxiety, inertia, impulsiveness, etc.) [5, 60, 61] thus explaining certain cases of apparently irrational resistance or inertia towards innovations or conditions of change [8, 9].

Other studies have highlighted that risk behaviour may be influenced also by other factors such as gender - male individuals tend to be more risk averse than female individuals due to differences in emotional responsiveness (female individuals are likely to report more and better imagery than male individuals) [7, 23] – or ageing - young individuals tend to underestimate the negative consequences of an event or the occurrence of the outcomes of risky behaviour due to differences in risk perceptions [57].

In addition risk may scale up at group and social level becoming a "diffused feeling of risk" [49] i.e. through anxiety induction (by consequences' intensity manipulation and amplification) thus becoming a sort of strategy to artificially induce defensive reactions, high levels of fear and anxiety and provoking defensive avoidance phenomena and information avoidance [33].

Thanks to WOM processes and reciprocal, self enforcing influences in behaviour within social groups with potential self-reinforcing feedback effects, fear and mistrust increase emotional stimuli and these stimuli intensify new fear and mistrust responses: for this reason relatively mild diffidence may rapidly soar into diffused total rejection, mild fears into panic with public concern or mistrust about a problem even unconnected with any sudden change in

the underlying risk. The resulting phenomena is a social amplification of risk [29] triggered by the occurrence of an adverse major/minor event, a discovery of unexpected consequences, economic losses, etc.: risk reactions may be transmitted by WOM, through percolation phenomena within social networks having scale free dynamics [11], or by media capable to turn a previously ignored or scarcely considered risk into a commonly shared risky opinion with potential consequences for a wide range of people. Risk amplification activates consequential waves and circular outward pushes propagating negative impacts of a given event far beyond the direct implications to the involved people and may be massively translated for example into non adoption of certain technologies, products or innovations. In particular WOM chains' multiple mechanisms imply that direct impacts need not to be too large to trigger major indirect impacts because negative-word-of-mouth (NWOM) propagates and amplifies feelings of risk [11] through a major emphasis to certain "signals" which alter the magnitude of risk and the adequacy of the risk-management process [6]. All this may explain for example why familiar and well-understood risks may produce relatively little social concern (a car accident even involving the loss of many lives) while a small incident in an unfamiliar or poorly understood risk dimension (nuclear energy, food additives, OGM, etc.) may have remarkable social impacts due to the amplification in magnitude if the event is perceived as a precursor of future and possibly catastrophic consequences [56]. Similarly it explains cases of irrational innovation rejection: being innovation characterized by structural uncertain features, the quantity and quality of the information base accompanying innovations or new technologies may act as signals of its eventual failure (with the associated financial costs and losses) when the risks associated to a given innovation are seen as poorly understood and catastrophic. Small innovation failures conveyed by NWOM and happened somewhere may be considered a premonition of a disaster or heavy economic losses everywhere generating emotional waves reflecting very wide psychological, socioeconomic and political impacts.

Doing the right thing and knowing the right thing to do

The gap between the emotional reactions of a farmer and professionals' considerations of risks related to innovation creates often relevant problems and significant questions for innovation diffusion and techno transfer managers. Innovation doesn't fall from above or grows in a "ground zero" condition but it is always connected to a realistic context [10, 42, 47] or "already existing mentalities, behaviors, attitudes, approaches and practices in managers and staff (consolidated environment)" thus encompassing also specific feelings, perceptions and visions about risk. The introduction of innovation in a farm may imply some risks sometimes difficult to quantify and identify in advance which however have to be taken into proper consideration to guarantee sustainable value to innovation and the related activities.

Farm's internal and external sources of risk or kind of activities unquestionably play a relevant role but also psychological attitudes, feelings and behaviours of the individuals involved, too often considered by proponents of formal analyses low profile issues or producing only irrational responses, occupy a not secondary position within this discussion. The adoption of theoretical mathematical models may provide only a partial explanation of these reactions because risk aversion pushes show more differentiated sources and dynamics not solely ascribed to crude economic or technical evaluations. Diverse problematic facets contribute simultaneously to generate a complex problematic issue in which those cases of innovation rejection cannot therefore be simply explained by hypothesis of innate conservatism/impulsiveness in certain firms, economic sectors or class of entrepreneurs. Farmer community is not homogenous in several ways and this diversity can be observed also in the differences to adopt new ideas, techniques or methods or propensity to rely on tried and familiar approaches.

The case study of the passage from conventional to organic agriculture has exemplified how, in general, decision maker's choices about the opportunity to adopt/non adopt innovation are inspired by the idea of "doing the right thing": this notion is however a composite entity because it includes risk management and control within an economic, sector and innovation dimension. Differentiating these dimensions into specialized problematic areas could be meaningless for farmers because the notion of doing the right thing may be inspired by economic or technical evaluations as well as environmental, cultural, personal or social motivations: this intricate array of pushes may even legitimate reasons for non adoption.

The identification of three main problematic dimensions, where different kind of risks simultaneously may operate, are thus embraced and encompassed by a forth one: the behavioural one. All this evidences how relevant their harmonization can be (figure 3) because technical needs (and the related best options) with different assessments of economic and technical risk exposition have to be considered with the essential support of the understanding and appreciation of the farmers' visions and opinions.

Different risk behaviours contribute to determine different "style of farming": this condition implies that

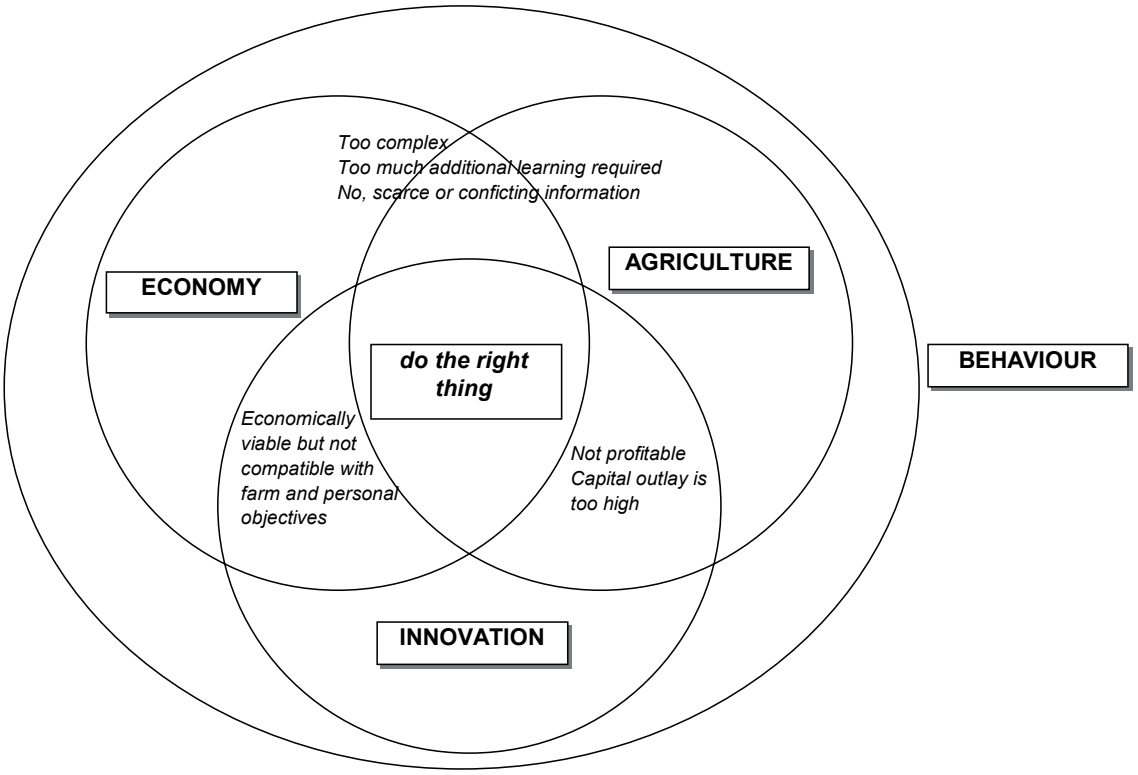

Figure 3: Operational dimensions involved in risk mitigation

any innovation diffusion programme should be linked to an appropriate and specific risk mitigation plan: this plan should be prepared, also considering gender and ageing characteristics given the differences in approaching to risk, on a particularly convincing basis related to positive experiences and mainly linked to concrete cases and known people rather than crude statistical data. This step is essential to help farmers, experts, researchers and extensionists in delineating together a correct problem framing background and mitigate real and perceived risks towards the achievement of the "right thing".

Furthermore, risk is surely quintessential in agricultural activities but eventual forms of innovation rejection or difficulties in innovation diffusion in rural areas cannot be described as a "mechanical" reply to context or sector conditions because the decision to adopt or not adopt in general is not a solitary choice made with little or no input from others: risk responses may be diffused, transmitted and amplified/reduced by culture and by imitation processes.

Ignoring the entrepreneurs' resistances and giving prevalence only to the expert's point of view may become a very counterproductive and costly approach [1, 13, 32, 44, 53] because it may intensify uncertainty clouds, mistrust, fears among farmers amplifying the magnitude of the (economic-technical) consequences of eventual innovation failures and additional costs. Scarce farmers' participation, poor understanding of their views, a marginalization of farmers' local knowledge, ignoring the social, political and cultural context where adoption should take place, are typical concrete symptoms of uni-directional techno transfer processes and top-down extension schemes, even when verbally asserting the contrary (table 5). This kind of approaches tend to consider adoption as a singular act of an individual within an isolated context while adoption is rather a socio-cultural process occurring in a heterogeneous scenario, where farmers share and discuss their visions with others, composed of different understandings, different way of working, different values, different views about how to farm, etc.. Therefore an evaluation, and eventual rethinking, of the actual modalities adopted in innovation diffusion is a critical precondition to recognize that farmers' needs may be very different and each farmer may opt for non adoption under given circumstances which are likely to be rational from the farmer's point of view. There are lots of reasons why a farmer may not have intention to adopt an innovation also on the base on a "reasonable" amount of risk to deal with and each farmer defines what is reasonable for himself.

Table 5: Farmers' reactions and constraints in an uni-directional techno transfer process

Farmers' Reactions	Constraint
Lack of farmers' confidence in training, extension and innovation	Approaches and language considered too academic and theoretical Judgment of farmers about risk ignored Overemphasis on technical aspects (other aspects of risk ignored or undervalued)
Disengagement, weak impact, low morale	Operative agenda doesn't address farmers' needs "Lab to Field" approach Unidirectional flow of information Farmers' feelings of risks ignored No active experimentations with farmers
Ineffective communication of useful information and scarce participation	Outdated, top-down extension methods
Lack of system approach	Key context socio-cultural issues ignored Farmers' expertise undervalued or ignored

CONCLUSIONS

A high risk aversion degree among farmers may render any innovation, even those directed to achieve a more sustainable agriculture, as something risky and uncertain: in case of small rural communities, where WOM, social stigma and peer pressures from other farmers may play a remarkable role, a relevant percentage of agents will be inclined to prefer immediate small short term results than manage forms of uncertainty in the mid-long run. When conformism is particularly pervasive and risk aversion widely shared, even financial incentives to stimulate innovation diffusion are unlikely to work properly because of the higher incidence of non-economic sources of opposition caused by the interaction of several variables placed in different risk dimensions. As the case study has evidenced, the transition from conventional to organic agriculture in fact is not simply a matter of substituting organic fertilizers for synthetic ones: sustainability in agriculture cannot be regarded only in biophysical or economic terms because it requires an essential cultural and philosophical shift within a broader notion of good farm management.

All this creates a concrete need for development agents to hold realistic expectations about the degree of the change that will occur. In this case, gradual changes and the identification of some pivotal individuals, showing more interest in innovation, opinion leadership and larger social networks: they usually know better than the "experts" what motivates people and, fundamentally, may stimulate imitative and positive WOM processes among less confident farmers and rural entrepreneurs with positive contributions in altering and interrupting conformist risk aversion behaviors.

REFERENCES

[1] Anderson J. R., Agricultural Extension: Good Intentions and Hard Realities, The World Bank Research Observer (2004) 19 (1): 41-60.

[2] Arrow K.J., The Theory of Risk Aversion. In: Essays in the Theory of Risk Bearing, Chapter 3, American Elsevier, New York, 1971, pp. 90-133

[3] Bammer G., Smithson M., (Eds.), Uncertainty and Risk: Multidisciplinary Perspectives, Earthscan, London, 2008.

[4] Beck U., Risk Society: Towards a New Modernity, SAGE, London, 1992.

[5] Bowling G. R., Perceived risk: The concept and its measurement, Psycology & Marketing (2006) 3 (3): 193-210.

[6] Burns W., Slovic P., Kasperson R., Kasperson J., Renn O., Emani S., Social amplification of risk: An empirical study, Carson City, NV: Nevada Agency for Nuclear Projects Nuclear Waste Project Office, 1990.

[7] Byrnes J. P., Miller D. C., Schafer W. D., Gender differences in risk taking : A meta-analysis, Psychological bulletin (1999) 125 (3): 367-383.

[8] Cannarella C. Piccioni V., Training as Innovation Device, New Educational Review 2006 8 (1): 115-140.

[9] Cannarella C. Piccioni V., Innovation Diffusion and Territorial Inertia, International Journal of Rural

Management 2007 3 (2): 181-211.

[10] Cannarella C., Piccioni V., Innovation Transfer and rural SMEs, Journal of Central European Agriculture (2003) 4 (4): 372-388.

[11] Cannarella C., Piccioni V., Bad news travel faster: the role of Word of Mouth in Innovation Diffusion in Rural Areas, New Educational Review (2008) 14 (1): 121-155.

[12] Chiles T. H., McMackin J. F., Integrating Variable Risk Preferences, Trust and Transaction Cost Economics, Academy of Management Review (1996) 21 (1): 73-99.

[13] Crawford A., Nettle R., Paine M., Kabore C., Farms and Learning Partnerships in Farming Systems Projects: A Response to the Challenges of Complexity in Agricultural Innovation, The Journal of Agricultural Education and Extension (2007) 13 (3): 191-207.

[14] Darnhofer I., Schneeberger W., Freyer B, Converting or not converting to organic farming in Austria:Farmer types and their rationale, Journal Agriculture and Human Values (2005) 22 (1): pp. 39-52.

[15] Drucker P. F., Innovation and Entrepreneurship: Practice and Principles, Oxford: Butterworth-Heinemann, 2007.

[16] Duram L. A., Factors in organic farmers' decision making: Diversity, challenge, and obstacles, American Journal of Alternative Agriculture (1999) 14 (1): 2-10.

[17] Epstein L. G., Behaviour under risk: recent developments in theory and applications, in Laffont J. J. (Eds.), Advance in economic theory, Cambridge University Press, 1992, pp. 1-63.

[18] Fetherstonhaugh D., Slovic P., Johnson S., Friedrich J., Insensitivity to the Value of Human Life: a Study of Psychophysical Numbing, Journal of Risk and Uncertainty (1997) 14 (3): 283-300.

[19] Fiegenbaum A., Thomas H., Attitudes toward risk and the risk-return paradox: prospect theory explanations, Academy of Management Journal (1988) 31: 85-106.

[20] Froot K. A., Scharfstein D. S., Stein J. C., A Framework for Risk Management, Journal of Applied Corporate Finance (2005) 7 (3): 22-33.

[21] Hanson J., Dismukes R., Chambers W., Greene C., Kremen A., Risk and risk management in organic agriculture: Views of organic farmers, Renewable Agriculture and Food Systems (2004) 19: 218-227.

[22] Hardaker J. B., Huirne R. B. M., Anderson J. R., Lien G., Coping with Risk in Agriculture, CABI, Wallingford UK, 2004.

[23] Harshman R. A., Paivio A., Paradoxical Sex Differences in Self-Reported Imagery, Canadian Journal of Psychology (1987) 41: 287-302.

[24] Henrich J., Cultural transmission and the diffusion of innovations, American Anthropologist (2001) 103 (4): 1-23.

[25] Henrich J., Gil-White F., The Evolution of Prestige: freely conferred deference as a mechanism for enhancing the benefits of cultural transmission, Evolution and Human Behavior (2001) 22 (3): 165-196.

[26] Henrich J., McElreath R., Are Peasants Risk Averse Decision Makers?, Current Anthropology (2002) 43 (1): 172-181

[27] Just R. E., Pope R. D., Agricultural Risk analysis: adequacy of models, data and iusses, American Journal of Agricultural Economics (2003) 85 (5): 1249-1256.

[28] Kahneman D., Tversky A., Prospect Theory: an analysis of decision under risk, Econometrica (1979) 47 (2): 263-291.

[29] Kasperson R. E., Renn O., Slovic P., Brown H. S., Emel J., Goble R., Kasperson J. X., Ratick S., The Social Amplification of Risk: A Conceptual Framework, Risk Analysis (1988) 8 (2): 177-187.

[30] Kobbeltved T., Brun W., Johnsen B. H., Eid J., Risk as feelings or risk and feelings? A cross-lagged panel analysis, Journal of Risk Research (2005) 8 (5): 417-437.

[31] Lazaric N., The role of routines, rules and habits in collective learning: Some epistemological and ontological considerations, European Journal of Economic and Social Systems (2000) 14: 157-171.

[32] Leeuwis C., Van den Ban A. (Contributions by), Communication for Rural Innovation: Rethinking Agricultural Extension, 3rd Edition, Blackwell Science Ltd, 2004.

[33] Leventhal H., Watts J., Sources of Resistance to Fear-Arousing Communications on Smoking and Lung Cancer, Journal of Personality (1996) 34: 155-175.

[34] Loewenstein G. F., Emotions in economic theory and economic behaviour, American Economic Review (2000) 90 (2): 426 432.

[35] Loewenstein G. F., Weber E. U., Hsee C. K., Welch E. S., Risk as feeling, Psychological Bulletin (2001) 127: 267-286.

[36] Loomes G., Segal U., Observing different orders of risk aversion, Journal of risk and uncertainty (1994) 9 (3): 239-256

[37] March J. G., Variable risk preferences and adaptive aspirations, Journal of Economic Behaviour and Organizations (1988) 9 (1): 5-24.

[38] Mayle D., Managing Innovation and Change, SAGE, London, 2006.

[39] Moore Lappè F., Collins J., Still hungry after all these years, Mother Jones (1977) San Francisco CA.

[40] Moschini G., Hennessy D. A., Uncertainty, Risk Aversion, and Risk Management for Agricultural Producers, in Gardner B. L., Rausser G. C. (Eds.), Handbook of Agricultural Economics, Amsterdam, North-Holland, 1 (1), 2001, pp. 88.153.

[41] Nelson R. R., Routines, in Hodgson G., Samuls W., Tool M. (Eds.), The Elgar Companion to Institutional and Evolutionary Economics, Edward Elgar: Aldershot, 2, 1994, pp. 249-253.

[42] O'Kane M. P., Paine M. S., King B. J., Context, Participation and Discourse: The Role of the Communities of Practice Concept in Understanding Farmer Decision-Making, The Journal of Agricultural Education and Extension (2008) 14 (3): 187-201.

[43] Otway H., Thomas K., Reflections on Risk Perception and Policy, Risk Analysis (2006) 2 (2): 69-82.

[44] Percy R., The contribution of transformative learning theory to the practice of participatory research and extension: Theoretical reflections, Agriculture and Human Values (2005) 22 (2): 127-136.

[45] Pratt J., Risk aversion in the small and in the large, Econometrica (1964) 32: 122-136.

[46] Prelec D., The Probability Weighting Function, Econometrica (1998) 66 (3): 497-527.

[47] Pretty, J N and Chambers, R. Towards a learning paradigm: new professionalism and institutions for a sustainable agriculture, in: Scoones I., Thompson J. (Eds), Beyond farmer first: Rural people's knowledge, agricultural research and extension practice. Intermediate Technology Publications, London, 1994, pp. 182-202.

[48] Rabin M., Thaler R. H., Anomalies: Risk Aversion, Journal of Economic Perspectives (2001) 15 (1): 219-232

[49] Raghunathan R., Pham M. T., All Negative Moods Are Not Equal: Motivational Influences of Anxiety and Sadness on Decision Making, Organizational Behavior and Human Decision Processes (1999) 79 (1): 56-77.

[50] Rogers E. M., Diffusion of Innovations, New York: Free Press, 1995.

[51] Rumelt, R. P., Inertia and transformation, in Montgomery C. A. (Eds.), Resource-Based and Evolutionary Theories of the Firm, Kluwer Academic Publishers, Massachusetts, 1995, pp. 101-132.

[52] Stewart W. H., Roth P. L., Risk propensity differences between entrepreneurs and managers : A meta-analytic review, Journal of Applied Psychology (2001) 86 (1): 145-153.

[53] Vanclay F., Social principles for agricultural extension to assist in the promotion of natural resource management, Australian Journal of Experimental Agriculture (2004) 44 (3): 213-222.

[54] Von Neumann J., Morgenstern O., Theory of Games and Economic Behavior, Princeton: Princeton University Press, 1953.

[55] Wang X. T., Emotions within Reason: Resolving Conflicts in Risk Preference, Cognition & Emotion (2006) 20 (8): 1132 – 1152.

[56] Weber E. U., Personality and risk taking, in Smelser N. J., Baltes P. B. (Eds.), International Encyclopedia of the Social and Behavioral Sciences, Oxford, UK: Elsevier Science Limited, 2001, pp. 11274-11276.

[57] Whitley B. E., Hern Jr. A. L, Perceptions of Vulnerability to Pregnancy and the Use of Effective Contraception, Personality and Social Psychology Bulletin (1991) 17 (1): 104-110.

[58] Winterhalder B., Lu E., Tucker B., Risk-sensitive adaptative tactics: Models and evidence from subsistence studies in biology and anthropology, Journal of Archaeological Research (1999) 7: 301-348.

[59] Yacov Y. Haimes, Risk Modeling, Assessment and Management, SAGE, London, 2005.

[60] Zajonc R. B., On the Primacy of Affect, American Psychologists (1984a) 39: 117-123.

[61] Zajonc R. B., The interaction of affect and cognition, in Scherer K. R., Ekman P. (Eds.), Approaches to emotion Hillsdale, NJ: Lawrence Erlbaum, 1984b, pp. 239-246.